Q-compensation imaging in the local angle-migrated domain for deep targets

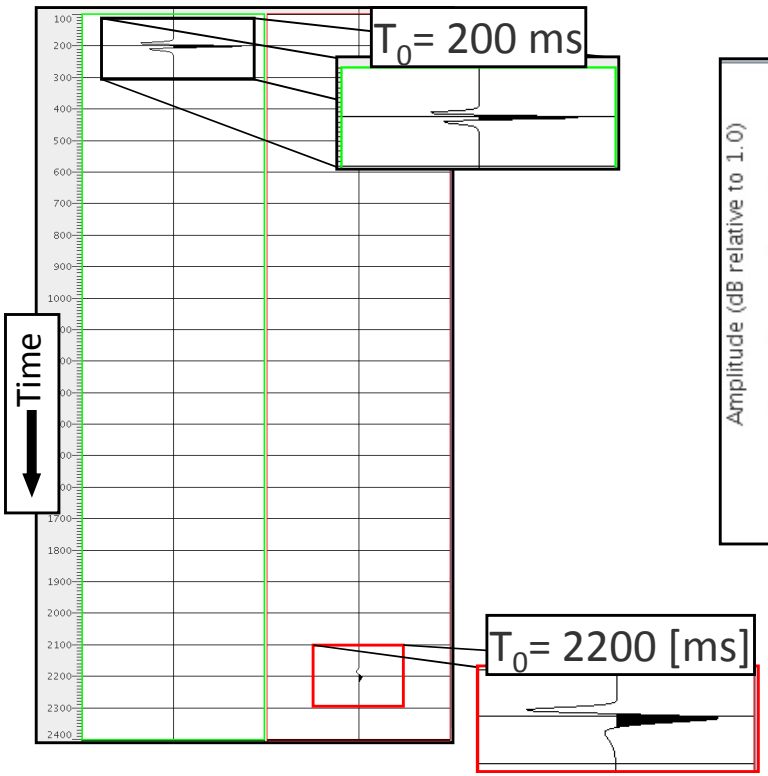
M. Podolak*, H. Kowalski, W. Kobusinski – Geofizyka Torun
G. Dekel – Paradigm Geophysical

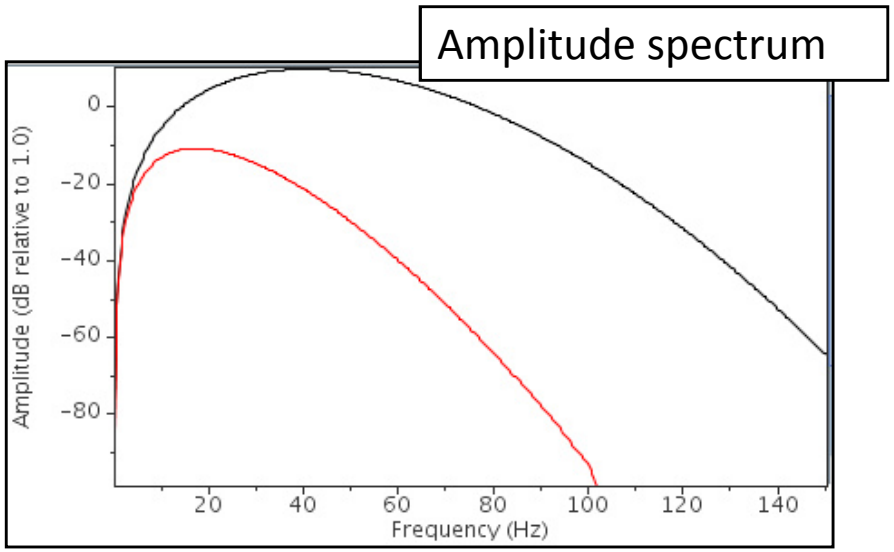
michal.podolak@gtservices.pl

Contents

- Introduction to the subject
- Q model estimation
- Test on synthetic seismic
- Application to real data
- Conclusions

Introduction – propagation changes wavelet





$A_t/A_0 = 3.2\%$
$\Delta\phi = 105°$

Inverse Q filter usually strives to reconstruct stationarity of wavelet

Q model estimation

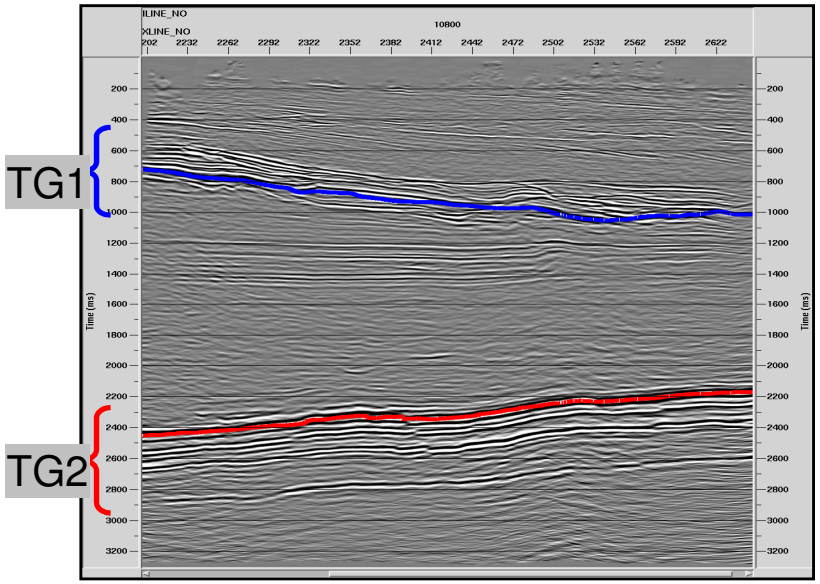
Estimation of Q for the inverse filter is based on the formula describing both: **dispersion** and **attenuation**:

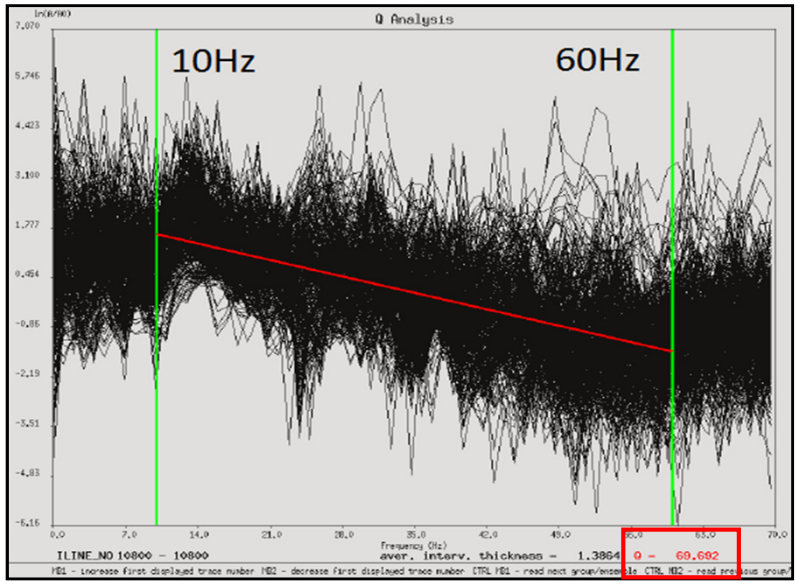
$$D(\text{Ray Pair}, \omega) = e^{-\frac{i\omega T^*}{\pi} \ln\left(\frac{\omega}{\omega_r}\right)} e^{\frac{\omega T^*}{2}}$$

where:

$\omega = 2\pi f$, f_r means reference frequency, T* denotes travel time integrated along the particular seismic ray pair.

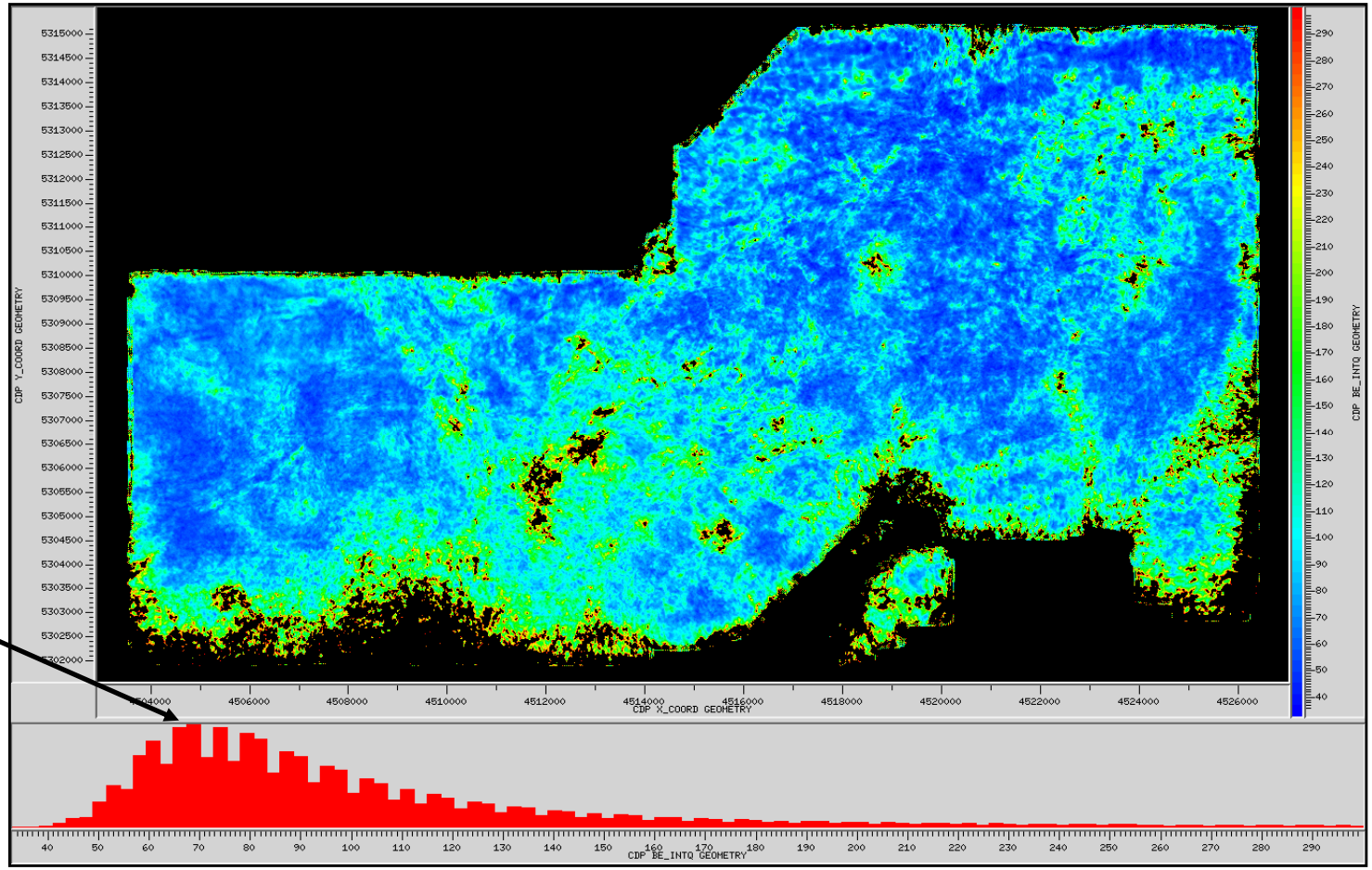
Example of Q estimation from seismic:
horizon gates (left), and statistics from seismic traces (right)



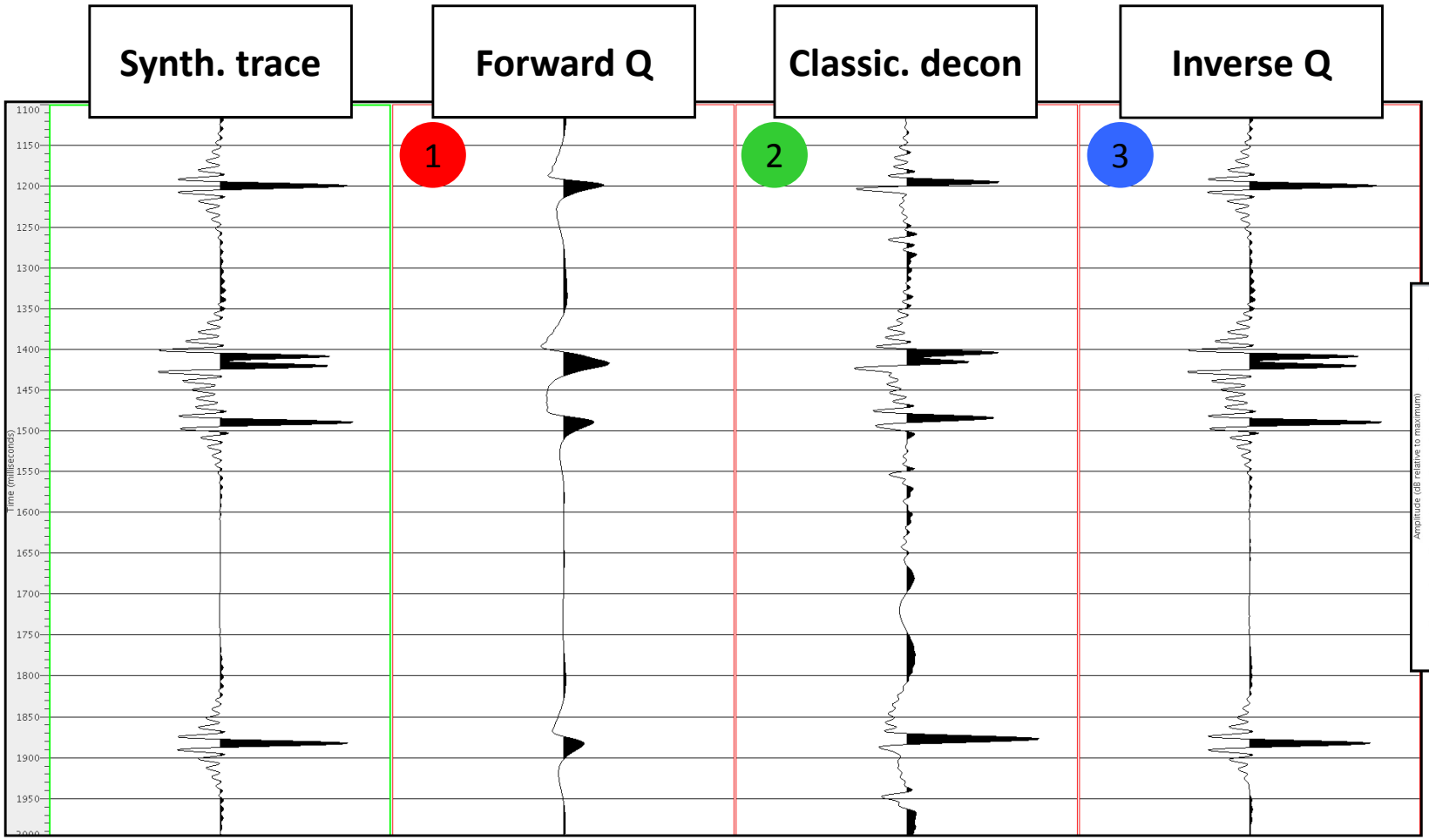


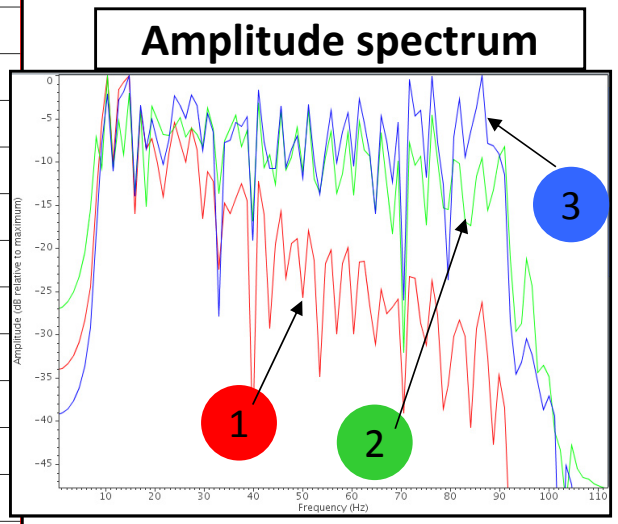
Q model estimation

Map of effective Q estimated along given horizon indicates stability of the estimation procedure

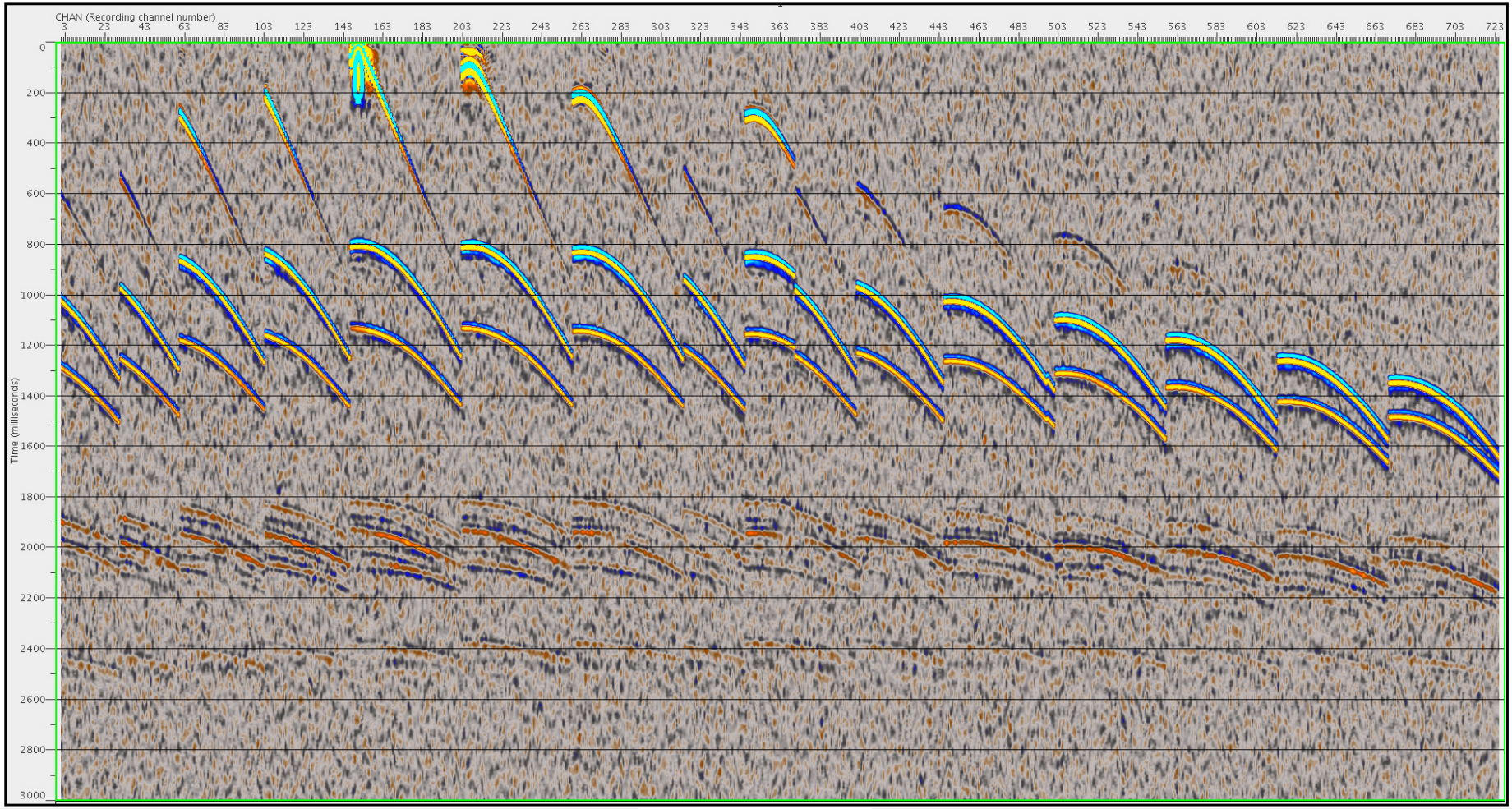


Test on synthetic seismic

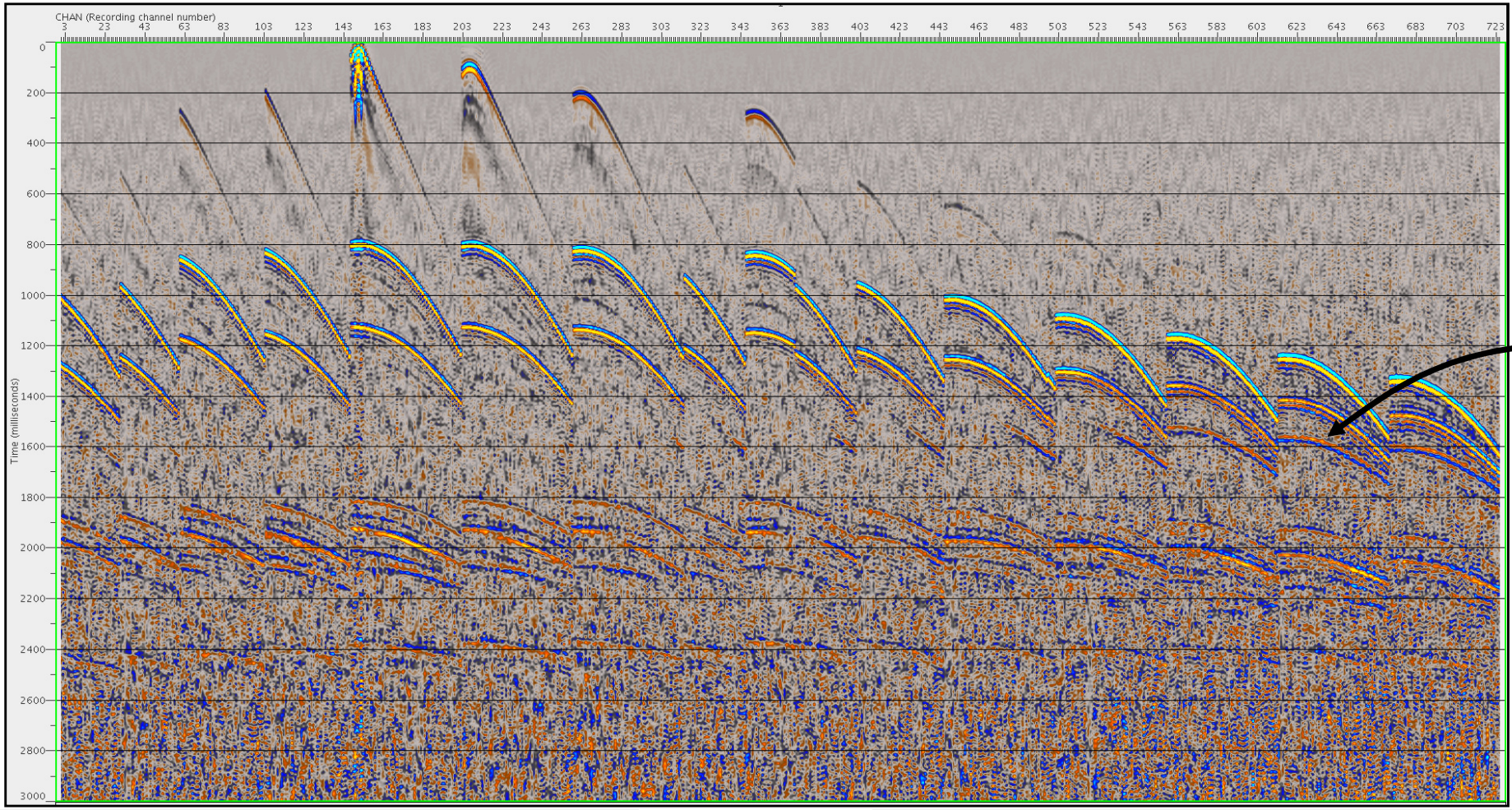




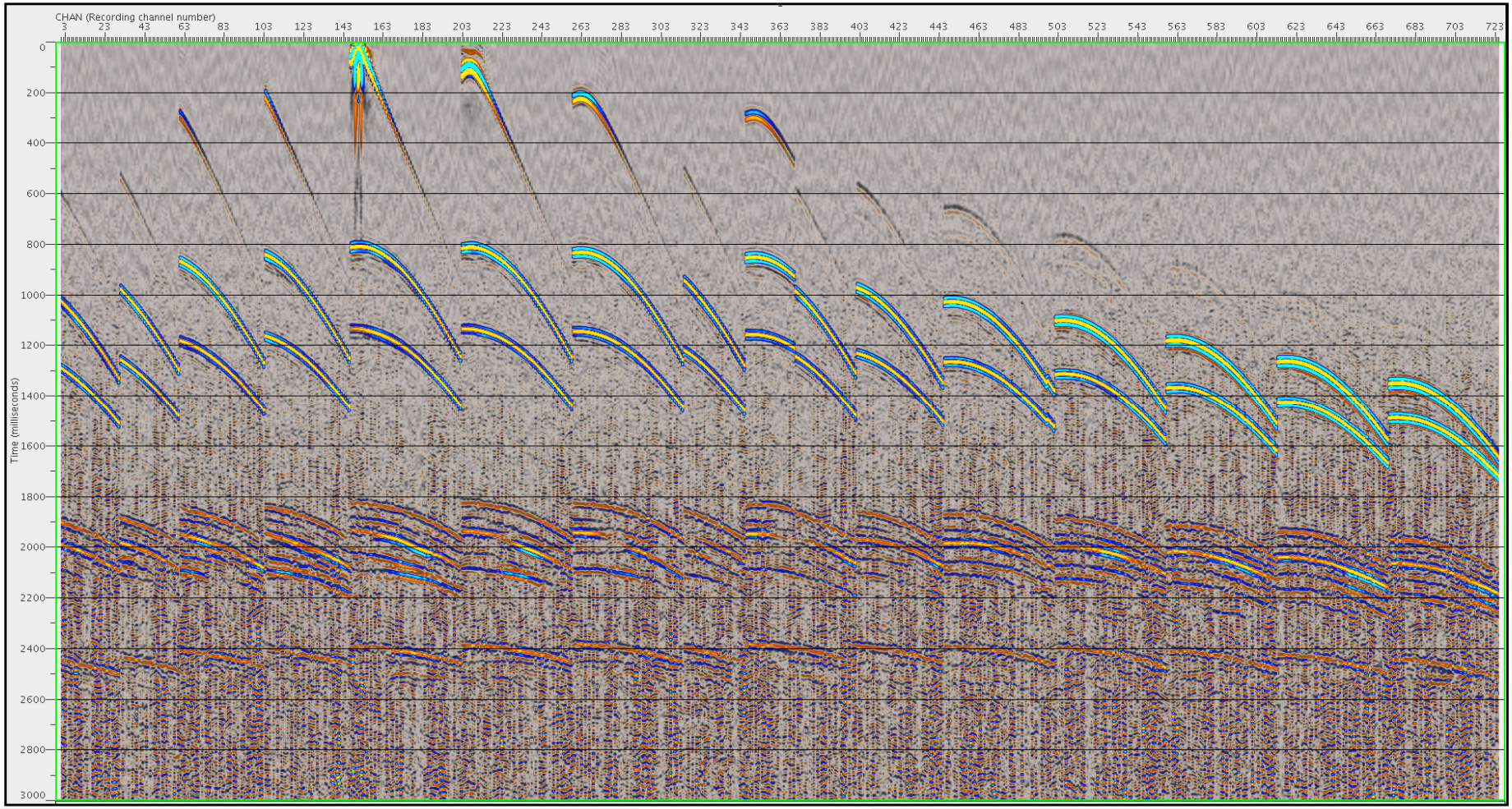
Test on synthetic seismic: 3D shot gather with fwd. Q and noise



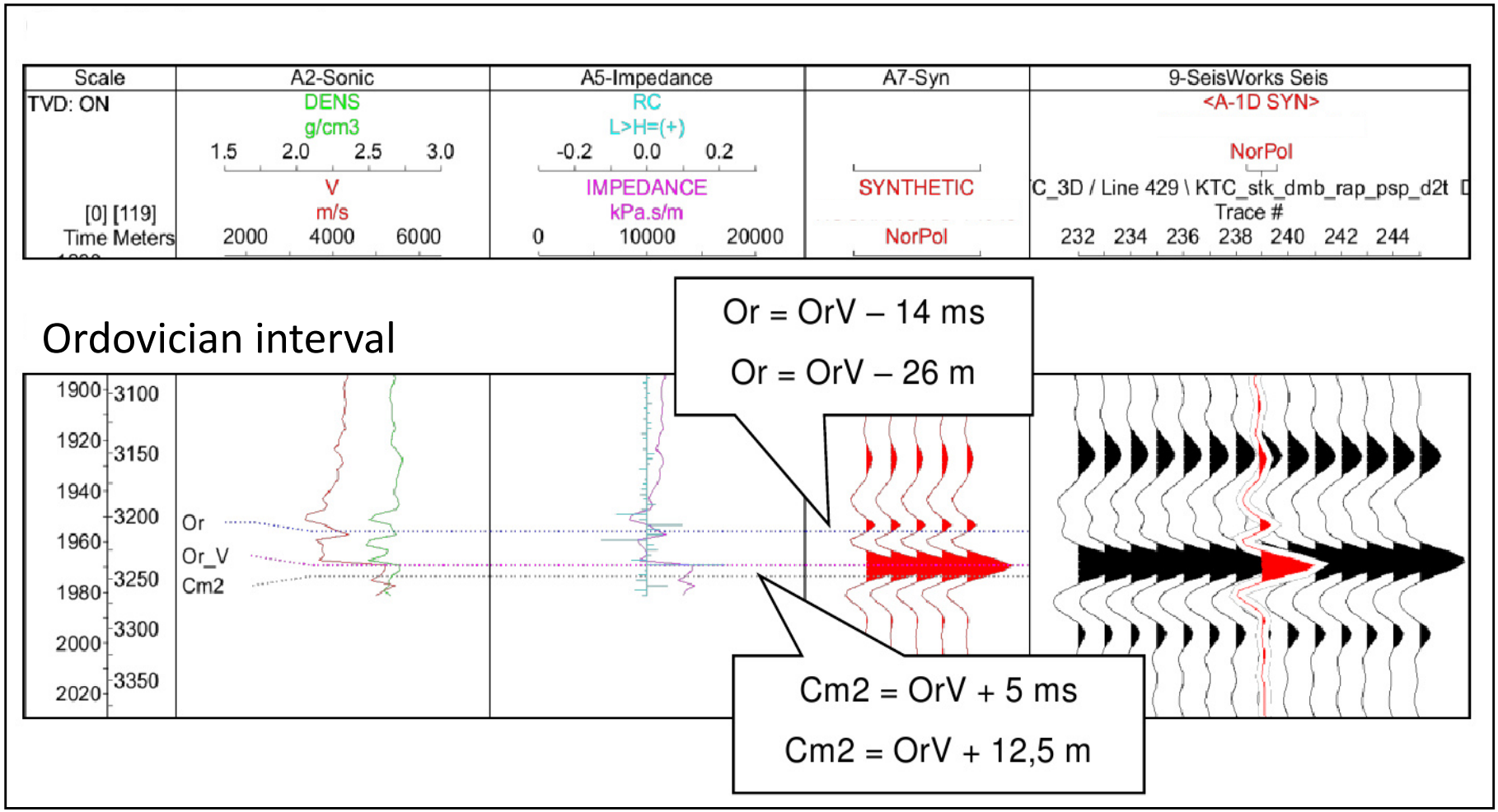
Test on synthetic seismic: 3D shot gather after spike decon



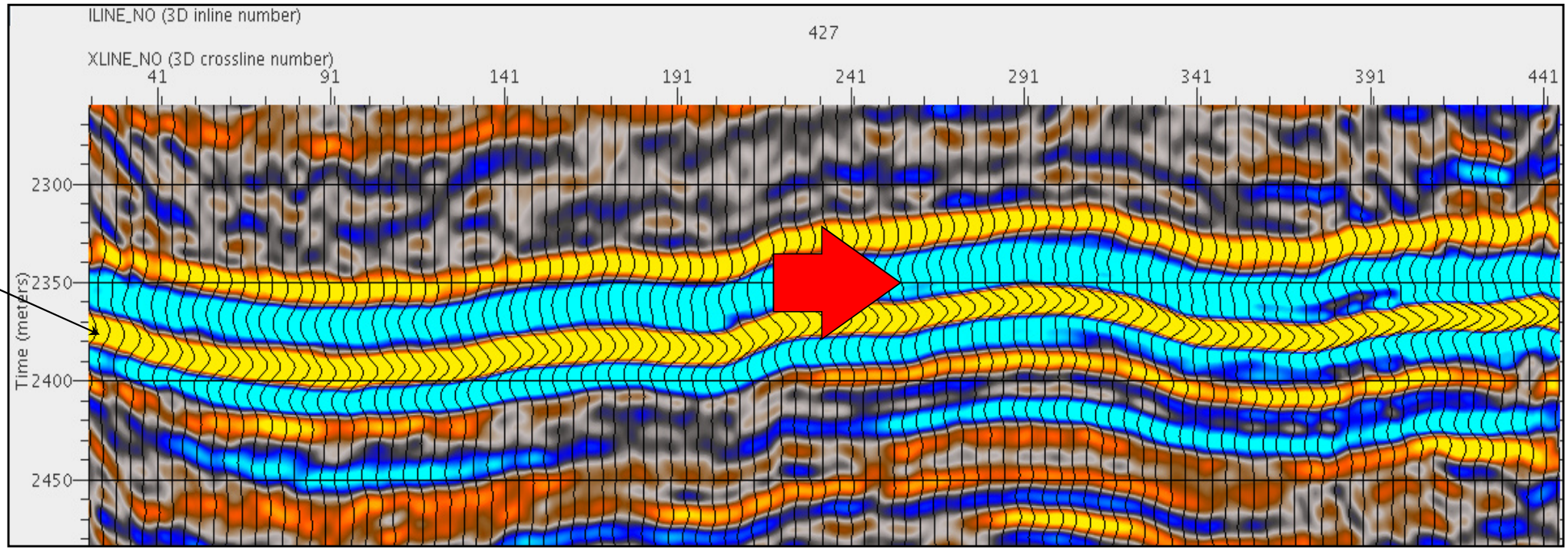
Test on synthetic seismic: 3D shot gather after inverse Q filter



Application to real data – stratigraphic matching in a well

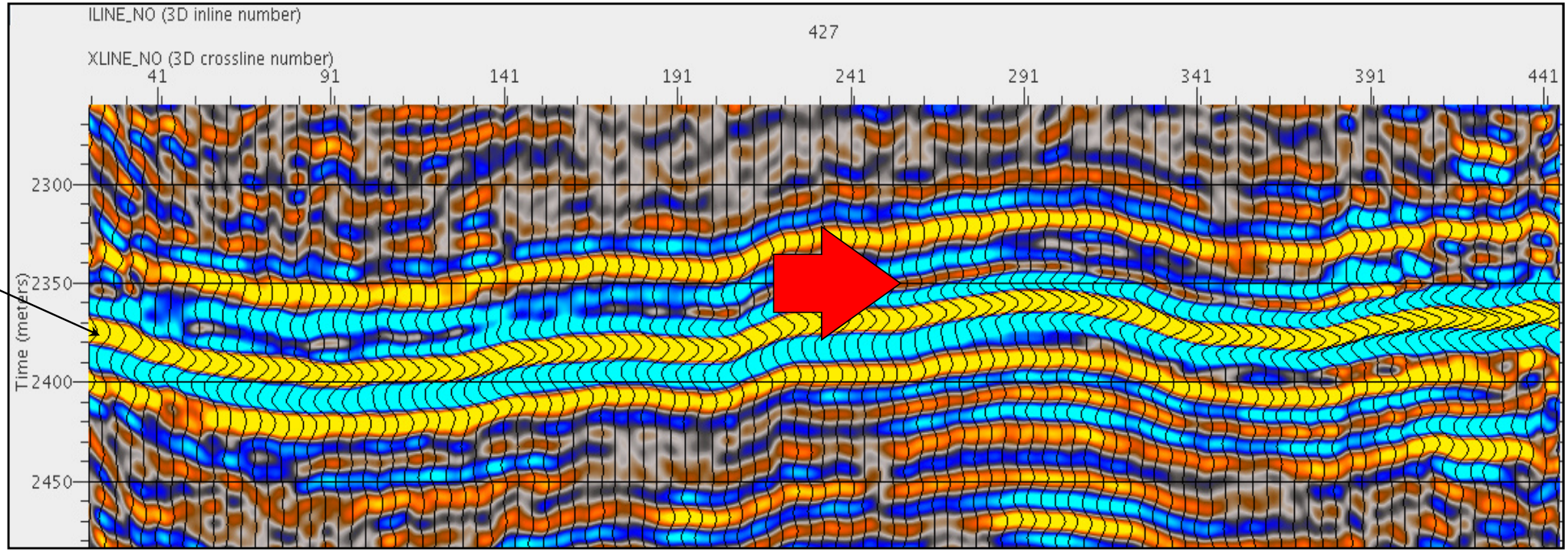


Application to real 3D project – final section without Q filter



OrV

Application to real 3D project – final section with inverse Q



Conclusions

- Estimation of dynamic and inelastic properties of rocks is as important as estimation of kinematic parameters: velocity or VTI
- Q model can be derived both from VSP or from surface seismic
- Application of Q filter in depth migration domain provides reliable and potentially better approach comparing to time domain application
- Correlation to well reference data, e.g. synthetic seismogram, assists in decision: traditional deconvolution or inverse Q filter delivers correct result
- Inverse Q filter can reveal deep seismic reflections when invisible otherwise, and being built into depth migration, has potential to recover reflections not only week, but also hidden in complicated seismic wavefield

Acknowledgements

PGNiG, Poland, is acknowledged for permission to publish selected images of their data

Algorithm for Q filter inside ES360™ prestack depth migration has been developed by Paradigm Geophysical

The presented case study and publication have been performed with support of Geofizyka Torun S.A.

michal.podolak@gtservices.pl

www.gtservices.pl